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ABSTRACT

Twenty college students participated in an examination of the role of auditory feedback in the encoding of paralinguistic affect by adults. A dependent measure indicating the accuracy of paralinguistic communication of affect was obtained by comparing the level of affect that encoders intended to produce with ratings of vocal intonations from adult judges. Five independent variables were manipulated: presence versus absence of auditory feedback to the encoder from his or her own voice; the literal content of the encoder's verbal message; the encoder's intended level of vocal intonation (extremely unfriendly, moderately unfriendly, neutral, moderately friendly, extremely friendly); the sex of the encoder; and the sex of the decoder. Five hypotheses were tested. The hypothesis that absence of auditory feedback would yield lower encoding accuracy than would presence of feedback was confirmed for friendly tones of voice. The hypothesis that absence of auditory feedback should yield a greater lowering of accuracy of encoding inconsistent than consistent paralanguage was also confirmed for friendly tones of voice. The hypothesis that absence of auditory feedback should yield a greater decrease of accuracy of encoding positive than negative paralinguistic inconsistency was confirmed. Contrary to prediction, females were more accurate encoders than were males (for friendly tones of voice only). The hypothesis that females should be more accurate decoders than males was confirmed (for the extremely unfriendly tones of voice only). (Author/FL)

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THE ROLE OF AUDITORY FEEDBACK IN THE ENCODING OF PARALINGUISTIC RESPONSES

by

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Report from the Project on
Studies of Instructional Programming for the Individual Student

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Abstract

This study examines the role of auditory feedback in the encoding of paralinguistic affect by adults. A dependent measure indicating the accuracy of paralinguistic communication of affect was obtained by comparing the level of affect which encoders intended to produce with ratings of vocal intonations from adult judges. Five independent variables were manipulated: (a) presence versus absence of auditory feedback to the encoder from his or her own voice; (b) the literal content of the encoder's verbal message (positive/negative); (c) the encoder's intended level of vocal intonation (extremely unfriendly, moderately unfriendly, neutral, moderately friendly, extremely friendly); (d) the sex of the encoder (male/female); and (e) the sex of the decoder (male/female). hypotheses were tested. The hypothesis that absence of auditory feedback should yield lower encoding accuracy than presence of feedback was confirmed for friendly (but not unfriendly) tones of voice. The hypothesis that absence of auditory feedback should yield a greater lowering (relative to presence of feedback) of accuracy of encoding inconsistent than consistent paralanguage was also confirmed for friendly (but not unfriendly) tones of voice. The hypothesis that absence of auditory feedback should yield a greater decrease (relative to presence of auditory feedback) of accuracy of encoding positive than negative paralinguistic inconsistency was confirmed. Contrary to prediction, females were more accurate encoders than males (but only for friendly tones of voice). Finally, the hypothesis that females should be more accurate

decoders than males was confirmed (but only for the extremely unfriendly tone of voice). Results are discussed according to a social skills model for encoding paralanguage.

The term "paralanguage" usually refers to all noncontent aspects of speech. The paralinguistic channel of communication is an important mode of conveying emotional meaning. Previous research has shown that individuals are able to accurately encode and decode emotional meaning by using vocal intonations alone (Davitz, 1964a). Moreover, research has shown that tone of voice is more heavily weighted than verbal content in interpreting the overall meaning of an emotional message (Mehrabian & Ferris, 1967; Mehrabian & Weiner, 1967). The present study examines the accuracy of encoding consistent and inconsistent paralinguistic messages. The social skills approach is an important theoretical perspective for conceptualizing the process of encoding paralanguage. An encoder is confronted with the practical problem of modulating vocal intonations so the intended level of meaning is communicated to a listener. To accomplish this goal, vocal inflections must be produced that approximate the stereotypical patterns conventionally associated with the intended meaning.

Previous research supports the social skills perspective indirectly, but with evidence from decoding rather than encoding processes. Davitz (1964b) found that two components--perceptual and cognitive factors--underlie the accurate decoding of vocal intonations. He found positive correlations between ability to decode paralinguistic cues and the following factors: (a) auditory ability--the ability to discriminate sounds in terms of pitch, loudness, duration, and timbre; and (b) knowledge of vocal characteristics--the ability to accurately describe how different emotions

are conveyed by paralinguistic dimensions such as loudness, pitch, timbre, rate of speech, inflection, rhythm, and enunciation. Thus, for the process of decoding, communicative ability was related to auditory activity and a cognitive awareness of stereotypical conventions of speech.

Although they have been linked empirically only to decoding ability, these two factors are roughly analogous to the two components that are theoretically linked to the encoding process according to a social skills approach. One component relevant to encoding is the abstract knowledge of stereotypical patterns for producing intelligible vocal intonations and practice in producing such patterns. A second component is the encoder's capacity for monitoring his or her own paralinguistic feedback in order to make the moment-to-moment modulations of voice that can maintain conformity to abstract stereotypes for encoding. Since previous research has shown that ability to encode and decode paralanguage are positively correlated (Levy, 1964), it is reasonable to expect that these components (which are also known to underlie decoding) can be extended to understand the encoding process as well.

In the present study the following variables were experimentally manipulated: First, the presence or absence of auditory feedback for the encoder; that is, the encoder either is permitted to hear the sound of his or her own voice while speaking or prevented from hearing it. Second, the relation between the literal content of an expression (positive versus negative) and five levels of paralinguistic affect (from extremely unfriendly to extremely friendly tone of voice) that encoders produced when encoding the expressions was examined. In other words, conditions

of communicative consistency (i.e., positive content expressed in friendly tones and negative content expressed in unfriendly tones) are created so that comparisons can be made with appropriate inconsistency conditions (i.e., positive content expressed in unfriendly tones and negative content expressed in friendly tones). In addition, sex of encoder and sex of decoder are included in the present study as independent variables in an attempt to replicate previously observed sex differences in accuracy of communication

Research Hypotheses

Hypothesis 1. The first hypothesis predicts that encoders will more effectively encode all levels of intentional paralinguistic affect when normal auditory feedback is present than when it is absent. In other words, judgments from decoders will show greater accuracy when the encoders are able to hear themselves speak and monitor vocal intonations of affect than when they are prevented from hearing their own voices while speaking.

This prediction of a main effect for the auditory feedback variable stems directly from the social skills approach. If the process of encoding paralanguage involves both an abstract cognitive ideal of how paralanguage ought to sound and the capacity to monitor with acuity whether one's vocal inflections actually follow such a stereotype while they are being produced, then inhibiting an encoder's ability to monitor vocal intonations should lower the accuracy of encoding affective meanings.

Hypothesis 2. Hypothesis 2 predicts that preventing auditory feedback to encoders will lower the accuracy of encoding paralanguage that is inconsistent with verbal content more than paralanguage that is

consistent with verbal content. An interaction effect is predicted between consistency and inconsistency conditions and the two conditions of auditory feedback for encoders (presence versus absence). Thus, the difference between accuracy of encoding paralanguage when auditory feedback is present versus absent will be greater for inconsistent than for consistent paralinguistic messages.

The reason for expecting the absence of auditory feedback to have a strong inhibiting effect on encoding inconsistent messages stems from emphasis on the cognitive, or learned, component of the social skills model described above. According to the premise advanced in an earlier paper (Plazewski & Allen, Note 1) that most paralinguistic messages in everyday life are consistent due to cultural norms (and therefore better learned than inconsistent messages), encoders should have less need of their own auditory feedback for monitoring whether paralanguage conforms to stereotyped patterns of intonation when encoding consistent messages than inconsistent ones. Therefore, interference of auditory feedback should be more inhibitory for the accurate encoding of inconsistent than consistent paralanguage.

Hypothesis 3. Hypothesis 3 predicts a differential effect of auditory feedback on encoding of two kinds of paralinguistic inconsistency, namely, positive inconsistency (positive vocal intonations encoded for messages with negative verbal content) and negative inconsistency (negative vocal intonations encoded for messages with positive inconsistency). In particular, the absence of auditory feedback is expected to have a stronger inhibiting effect on encoders' production of positive inconsistency

than negative inconsistency.

The rationale for this prediction is similar to that advanced for hypothesis 2. Plazewski and Allen (Note 1) suggested that negative paralinguistic inconsistency is more often encoded in daily interaction than positive inconsistency. Norms of social desirability presumably constrain most of everyday language to be positive in content, leaving negative effect to be conveyed paralinguistically or nonverbally. Plazewski and Allen's (Note 1) results supported this contention indirectly, by showing that children encode negative paralinguistic inconsistency more accurately than positive inconsistency, apparently because greater practice or more exposure to negative inconsistency makes it easier to encode at will. According to the social skills model advanced in the present paper, if the stereotypical pattern for encoding negative paralinguistic inconsistency is better learned and more readily produced due to practice than positive inconsistency, then the monitoring of paralinguistic feedback should be less essential for producing negative inconsistency that conforms to the desired pattern than for producing positive paralinguistic inconsistency. Therefore, a stronger inhibitory effect of absence of auditory feedback is expected for positive than for negative paralinguistic inconsistency.

Hypothesis 4. Males are predicted to be more accurate encoders of paralinguistic affect than females. This finding has been previously reported in research using children as encoders (Plazewski & Allen, Note 1). The present study attempts to replicate the finding using adult encoders engaged in a similar encoding task. This hypothesis warrants further testing because evidence for sex differences in encoding

paralanguage is sparse, and because there are theoretical reasons to expect generalization to paralanguage of the superior expressive abilities of females with respect to language skills (Maccoby & Jacklin, 1974) and nonverbal behavior (Buck, 1975).

Hypothesis 5. It is predicted that females will be more accurate as decoders than males. This result has been observed in at least four previous studies (Dimitrovsky, 1964; Dusenberry & Knower, 1939; Pfaff, 1953; Plazewski & Allen, Note 1). However, the reliability of this finding across research paradigms is worthy of further testing, because one study found the opposite effect (Fay & Middleton, 1940) and one study found no sex difference in the accuracy of decoding paralanguage (Levy, 1964). The present study provides additional data concerning this hypothesis.

Method

Overview

In the first phase of the study, 20 encoders were tape-recorded individually while attempting to encode standard verbal utterances along with various vocal intonations according to a prepared script. In the second (decoding) phase, 20 adult subjects listened to portions of these stimulus tapes and made judgments about the tone of voice used by each encoder. Accuracy of paralinguistic communication was determined by comparing decoders' judgments with each corresponding level of vocal intonation intended by encoders.

Encoders

A group of 10 male and 10 female undergraduates at the University of Wisconsin served as encoders in the study. The vocal intonations encoded by these participants comprised the stimulus materials later judged by decoders. Encoders received credit in an introductory psychology course in exchange for their participation.

Stimulus Materials

The stimulus persons (encoders) were tape-recorded individually by a male experimenter who followed a prepared script when guiding the encoder through each step in the session. The experimenter began each session by explaining that he was interested in the way college students can say particular sentences (i.e., "That was the right answer" and "That was the wrong answer") in different tones of voice. The encoder was instructed to "pretend you are teaching another student" while

saying each sentence aloud in five different vocal intonations. The encoder then examined a straight line (24 cm in length) that was anchored at the left end with a vertical mark signifying an "extremely friendly voice." The experimenter asked the encoder to imagine that points along the line corresponded to degrees of friendliness and unfriendliness in vocal intonation. Then the experimenter pointed to appropriate places on the line as illustrations while describing verbally the five levels of vocal intonation the encoder should try to produce. The distances from the left end of the line for these intended levels of vocal intonation were 0 cm for the extremely unfriendly vocal intonation, 6 cm for the moderately unfriendly vocal intonation, 12 cm--the center of the line--for the neutral tone of voice, 18 cm for the moderately friendly vocal intonation, and 24 cm for the extremely friendly vocal intonation.

The encoder was asked to practice saying the word "hello" five times while attempting to produce each level of vocal friendliness. The encoder was then permitted to practice freely the stimulus sentences for 3 minutes.

Immediately after practice, half of the encoders produced their recitations of the sentences, first under the normal auditory feedback condition and then under an auditory feedback absent condition. For half the encoders these conditions were reversed to achieve counterbalancing. Under the normal auditory feedback condition, encoders recited both sentences at all levels of vocal intonation while they were able to hear their own voices in a normal way. Under the auditory feedback absent condition, encoders produced the same recitations while they were unable

to hear their voices. This was achieved by asking encoders to wear earphones emitting noise while reciting the sentences. The noise emitted by earphones was white noise initially recorded at 7-1/2 ips, but played back from a tape recorder at 3-1/2 ips. The slower speed for playback lowered the frequency of white noise, thereby making it a more effective interference with hearing the sounds of adult voices.

The order of presentation of the positive and negative sentence was determined randomly. Each sentence was recited by the encoder five times (once for each level of vocal intonation) with the order of the five levels of intonation also determined randomly. Thus, both the order of presenting positive and negative sentences and the order for producing the five levels of vocal intonation for each sentence were completely randomized for each stimulus person both for encoding under the normal auditory feedback condition and also for encoding under the feedback absent condition. All 20 vocal presentations were tape-recorded for each encoder, with 5 seconds of silence recorded between each recitation.

Decoders

Decoders were 20 undergraduates (10 males and 10 females) at the University of Wisconsin. Subjects volunteered to participate in the study in exchange for course credit. Adults rather than children were employed as decoders on the assumption that adult interpreters are the most sensitive available instrument for detecting differences in paralinguistic affect.

Decoding Procedure

The decoders responded in groups of four (two males and two females).

Each group of decoders listened twice to all the vocal presentations from all encoders (10 males and 10 females), and judged the vocal intonation for each recitation after the second listening. For each group of decoders, the decoding was accomplished in two sessions of approximately 2 hours duration to assure that fatigue and boredom could not interfere with decoders' ability to make careful judgments.

The experimenter told each group of decoders that they would hear college students, in the role of a teacher, attempt to produce different levels of vocal intonation while saying common sentences used in teaching. Decoders were instructed to judge "the degree of friendliness or unfriendliness of just the tone of voice used for each presentation" and to record their judgments by placing a mark at the appropriate place on a line (24 cm in length). The line extended from "extremely unfriendly voice" printed at the left end to "extremely friendly voice" at the right end (identical to the line used in encoding). Instructions stressed that judgments should be based on the degree of friendliness or unfriendliness of the vocal intonation alone, without regard to the content of the sentences.

The five recitations of a stimulus person's encoding a given sentence were always presented once before making judgments. Therefore, before recording their judgments the decoders were exposed to the full range of vocal intonations encoders had produced with a given stimulus. The five recitations were immediately presented a second time, with 5 seconds of silence for making judgments. Each decoder made a total of 400 judgments (20 for each of 20 stimulus persons).

Dependent Variable

One dependent variable was derived from the judgments of decoders. First, a measure was taken of the absolute level of paralinguistic affect produced by encoders, which was operationally defined as the location (measured at .1 cm) of the decoder's judgment on the scale. The dependent variable (accuracy of communication of the intended level of paralinguistic affect) was derived from this score. Accuracy of paralinguistic communication was operationally defined as the absolute value of the difference between the encoder's intended level of vocal intonation and decoder's judgment.

Method of Analysis

A 2 x 2 x 2 x 2 x 5 mixed design analysis of variance was performed on absolute judgments and on accuracy scores of the decoders. The between-subjects factor was sex of decoder (male/female). The within-subject factors were sex of encoder (male/female), auditory feedback condition (normal feedback, feedback absent), verbal content (positive/negative), and intended level of vocal intonation (five levels from extremely unfriendly to extremely friendly).

Results

Results of the analysis of variance for accuracy scores are presented in Table 1. Of the eight effects that attained statistical significance, three will not be presented and discussed because they are not relevant to the theoretical orientation of this study (the main effect of sentence content, the main effect of intended level of vocal intonation, and the sex of encoder x auditory feedback condition x sentence content interaction effect). The remaining five effects in Table 1 that attained statistical significance will be presented in detail. These are the main effect for sex of encoder ($p < .01$) and the following interaction effects: sex of decoder x intended level of vocal intonation ($p < .01$), sex of encoder x intended level of vocal intonation ($p < .01$), auditory feedback x intended level of vocal intonation ($p < .01$), sentence content x intended level of vocal intonation ($p < .01$), and auditory feedback x sentence content x intended level of vocal intonation ($p < .01$). These results will be examined in relation to the hypotheses presented earlier. When reading mean accuracy scores, it should be remembered that smaller numbers indicate greater accuracy of communication.

The interaction effect between auditory feedback conditions and level of intonation provides limited support for hypothesis 1. The predicted decrease in accuracy of encoding did not occur at all the levels of intended vocal intonation. However, data in Table 2 show that accuracy decreased significantly as a function of absence of auditory feedback when encoders attempted to produce both levels of friendly tones of

Table 1

Analysis of Variance for Decoders' Accuracy in Judging the Tone of Voice of the Encoders

Source	df	MS	F
Between subjects			
Sex of decoder (A)	1	60.95	2.78
(error)	18	21.93	--
Within subjects			
Sex of encoder (B)	1	107.46	17.19**
A x B	1	8.44	1.35
(error)	18	6.25	--
Auditory feedback conditions (C)	1	2.79	.47
A x C	1	.13	.02
(error)	18	5.96	--
B x C	1	1.33	.31
A x B x C	1	.15	.03
(error)	18	4.28	--
Sentence content (D)	1	26.29	5.49*
A x D	1	2.60	.54
(error)	18	4.79	--
B x D	1	.32	.08
A x B x D	1	1.17	.28
(error)	18	4.12	--
C x D	1	.00	.00
A x C x D	1	13.16	3.50
(error)	18	3.76	--
B x C x D	1	20.42	6.02*
A x B x C x D	1	5.06	1.49
(error)	18	3.39	--
Intended level of vocal intonation (E)	4	738.51	63.84**
A x E	4	55.60	4.81**
(error)	72	11.57	--
B x E	4	82.67	33.13**
A x B x E	4	1.17	.47
(error)	72	2.50	--

Table 1 (continued)

Source	df	MS	F
C x E	4	92.74	26.97**
A x C x E	4	1.39	.40
(error)	72	3.44	--
B x C x E	4	4.71	1.81
A x B x C x E	4	.24	.09
(error)	72	2.61	--
D x E	4	136.02	51.11**
A x D x E	4	3.12	1.17
(error)	72	2.66	--
B x D x E	4	6.00	2.33
A x B x D x E	4	2.48	.96
(error)	72	2.57	--
C x D x E	4	9.98	4.13**
A x C x D x E	4	3.87	1.60
(error)	72	2.42	--
B x C x D x E	4	2.41	1.06
A x B x C x D x E	4	1.33	.58
(error)	72	2.27	--

*$p < .05$.

**$p < .01$.

Table 2

Decoders' Accuracy Scores as a Function of Auditory Feedback Conditions and Intended Level of Vocal Intonation

Auditory feedback condition	Intended level of vocal intonation				
	Extremely unfriendly	Moderately unfriendly	Neutral	Moderately friendly	Extremely friendly
Normal feedback	7.05_{a}	4.30_{b}	3.17_{c}	4.33_{d}	7.78_{e}
Feedback absent	4.82_{bf}	3.50_{b}	2.98_{c}	5.32_{f}	9.43_{g}

Note. Smaller numbers indicate greater accuracy of communication. Means with different subscripts differ at $p < .05$, HSD. (A difference between means of greater than 1.13 is significant at $p < .01$, HSD.)

voice, but not when they attempted to encode neutral and unfriendly tones of voice. Post hoc tests showed that absence of auditory feedback resulted in significantly less accuracy of encoding for the moderately friendly tone of voice ($p < .05$, HSD) and for the extremely friendly tone of voice ($p < .01$, HSD). No significant differences occurred between the auditory feedback conditions at the neutral and moderately unfriendly levels of vocal intonation. Contrary to prediction, encoders were significantly more accurate in producing the extremely negative tone of voice when they could not hear themselves speak than when they were given auditory feedback ($p < .01$, HSD). Perhaps absence of auditory feedback causes encoders to speak loudly when producing extremely negative tones of voice, and this contributes to the production of harsh and unfriendly intonations. In any event, hypothesis 1 was confirmed only for the positive levels of vocal intonation.

The three-way interaction for auditory feedback condition x sentence content x intended level of vocal intonation bears on both hypotheses 2 and 3. Table 3 presents mean accuracy scores by condition for this interaction. Post hoc tests showed that hypothesis 2 held for the moderate level of friendly vocal intonations. As predicted, at this level, prevention of auditory feedback significantly lowered accuracy of encoding on the negative sentence (inconsistency) but not on the positive sentence (consistency). Specifically, for the moderately positive level of intonation, inconsistent paralanguage was significantly more accurately encoded under the presence of auditory feedback ($M = 6.30$, $p < .10$, HSD); however, the accuracy of encoding consistency was not affected by the

Table 3

Decoders' Accuracy Scores as a Function of Auditory Feedback Conditions, Sentence Content and Intended Level of Vocal Intonation

Auditory feedback condition	Sentence content	Intended level of vocal intonation				
		Extremely unfriendly	Moderately unfriendly	Neutral	Moderately friendly	Extremely friendly
Normal feedback	Positive	7.64	4.66	3.60	3.60	6.20
	Negative	6.46	3.94	2.74	5.05	9.36
Feedback absent	Positive	6.06	3.68	2.84	4.34	8.24
	Negative	3.59	3.32	3.12	6.30	10.62

Note. Smaller numbers indicate greater accuracy of communication. (A difference between means of greater than 1.29 is significant at $p < .05$, HSD; a difference between means of greater than 1.48 is significant at $p < .01$, HSD.)

auditory feedback conditions (M = 3.61 vs 4.34, ns).

Hypothesis 2 did not hold at the extremely positive level of vocal intonation, but the results can be reconciled with the predicted effect. At this level, inconsistent paralanguage was significantly more accurately encoded under the presence of auditory feedback (M = 9.36) than under the absence of auditory feedback (M = 10.62, p < .10, HSD). However, the effect of auditory feedback conditions was even more pronounced for the encoding of consistent paralanguage (M = 6.20 vs 8.24, respectively, p < .01, HSD). In other words, absence of auditory feedback resulted in a more pronounced decrease in accuracy of encoding for consistent than for inconsistent paralanguage at the extremely friendly level of intended vocal intonation. This result is probably due to a "basement" effect stemming from the encoders' unexpectedly low accuracy of producing inconsistent friendly intonations under the presence of auditory feedback, rather than failure of prevention of auditory feedback to show its predicted effect. Perhaps negative sentences are so rarely spoken with extremely friendly vocal inflection that it is difficult to achieve even a moderate level of accuracy when encoding under a normal speech condition. Consequently, it may be all the more difficult to achieve accuracy under a condition where auditory feedback is prevented.

Contrary to hypothesis 2, no differential effect of auditory feedback conditions on accuracy of encoding consistency and inconsistency with a moderately negative level of vocal intonation was observed. Moreover, at the extremely negative level of intonation, hypothesis 2 was directly refuted because accuracy of encoding increased for both consistent

and inconsistent vocal intonations. As noted previously, it appears that absence of auditory feedback generally enhances the production of extremely negative tones of voice.

Overall, hypothesis 2 was directly supported only at the moderate level of friendly intonation. However, the opposite effect occurred at the extremely negative level of vocal intonation.

Hypothesis 3 was supported for all relevant comparisons. As predicted, at moderate levels of vocal intonation, positive inconsistency (friendly intonation/negative sentence) was significantly less accurately encoded when auditory feedback was absent than when auditory feedback was present ($\underline{M}$ = 6.30 vs 5.05, $\underline{p} < .10$, $\underline{HSD}$), whereas the accuracy of encoding negative inconsistency (unfriendly intonation/positive sentence) did not show a decrease under the absence of auditory feedback. Likewise, for the appropriate comparisons at the extreme levels of intonation, positive inconsistency was significantly less accurately encoded when auditory feedback was absent than when auditory feedback was present ($\underline{M}$ = 10.62 vs 9.36, $\underline{p} < .10$, $\underline{HSD}$), whereas the accuracy of encoding negative inconsistency actually increased under absence of auditory feedback relative to the presence of auditory feedback ($\underline{M}$ = 6.05 vs 7.64, $\underline{p} < .01$, $\underline{HSD}$). Thus, hypothesis 3 was strongly confirmed.

Hypothesis 4 received partial support. An overall sex difference in encoding was found opposite to the predicted effect. Accuracy scores for female encoders ($\underline{M}$ = 4.90) showed significantly more accuracy than scores for males ($\underline{M}$ = 5.63, $\underline{p} < .01$). However, an interaction between sex of encoder and intended level of vocal intonation qualified this effect.

Table 4 shows that females were significantly more accurate encoders than males only when expressing all levels of friendly tones of voice ($p < .01$, HSD). In contrast, males tended to be more accurate encoders when expressing the extremely unfriendly tones of voice, but it was only when expressing the extremely unfriendly tone that males were significantly more accurate than females ($M = 5.41$ vs 6.42, $p < .01$, HSD). Thus, the present data partially support hypothesis 4 by indicating that males are more accurate encoders of unfriendly tones of voice, whereas females are more accurate encoders of friendly tones of voice.

Hypothesis 5 also received only partial support. Although females tended to be more accurate decoders of both friendly and unfriendly tones of voice, as predicted, this difference attained statistical significance only at the extremely unfriendly level of vocal intonation. As shown in Table 5, the mean accuracy scores for the extremely unfriendly tone of voice were 4.88 for females and 6.99 for males, $p < .01$, HSD. It appears that although females tend to be more accurate decoders of all levels of vocal intonation except the neutral level, they are particularly sensitive to extremely negative tones of voice.

Table 4

Decoders' Accuracy Scores as a Function of Auditory Feedback Conditions and Intended Level of Vocal Intonation

Sex of encoder	Intended level of vocal intonation				
	Extremely unfriendly	Moderately unfriendly	Neutral	Moderately friendly	Extremely friendly
Male	5.45_{a}	3.76_{be}	3.38_{be}	5.85_{ad}	9.76_{c}
Female	6.42_{d}	4.06_{b}	2.78_{e}	3.79_{b}	7.45_{f}

Note. Smaller numbers indicate greater accuracy of communication. Means with different subscripts differ at $p < .01$, HSD.

Table 5

Decoders' Accuracy Scores as a Function of Sex of Decoder and Intended Level of Vocal Intonation

Sex of decoder	Intended level of vocal intonation				
	Extremely unfriendly	Moderately unfriendly	Neutral	Moderately friendly	Extremely friendly
Male	6.99_{a}	4.03_{bc}	2.54_{b}	4.99_{c}	9.17_{d}
Female	4.88_{c}	3.77_{bc}	3.62_{be}	4.65_{ce}	8.04_{ad}

Note. Smaller numbers indicate greater accuracy of communication. Means with different subscripts differ at $p < .01$.

Discussion

The important findings in the present study concern the effects of auditory feedback on the accuracy of encoding affective responses by the paralinguistic channel. Data provided partial support for the predictions. Hypothesis 1 predicted lower encoding accuracy when auditory feedback was absent than when feedback was present. Data supported the hypothesis for encoding positive paralinguistic affect, but not for negative affect.

Hypothesis 2 predicted a greater decrease in accuracy of encoding inconsistent than consistent paralanguage in the absence of auditory feedback. Data also conditionally supported this hypothesis for encoding positive levels of paralinguistic affect, but not for negative affect.

Hypothesis 3 predicted a greater decrease in accuracy of encoding positive than negative inconsistency when auditory feedback was absent. Results fully supported this hypothesis.

In addition to testing theoretical hypotheses, data from the present study were obtained for encoding and decoding abilities as a function of sex. Contrary to hypothesis 4, females were more accurate encoders than males when encoding positive levels of paralinguistic affect, but these differences failed to attain statistical significance. Finally, hypothesis 5 predicted that females would be more accurate decoders of paralanguage. This was confirmed only when the level of intonation decoded was extremely negative. Results showed that the tendency for females to be more accurate decoders of other levels of paralinguistic

affect did not attain statistical significance. These results are discussed in detail below.

Sex Differences in Encoding and Decoding

The present study showed that females were more accurate encoders of positive vocal intonations than males, whereas there was an opposite (nonsignificant) tendency for negative vocal intonations. The present results are the best data existing on adult sex differences in paralinguistic encoding. The data demonstrate that the sex differences favoring male encoders, observed in an earlier study (Plazewski & Allen, Note 1) using children as encoders, is not replicated with adults. This difference between studies probably reflects age differences in the populations used as encoders. In the present study the males who encoded paralanguage had fully mature voices rather than prepubescent voices. The mature male voice quality, having lower pitch, may be less able to communicate positive affect than the higher-pitch voices of adult females, because convention associates friendliness with higher pitch.

Another possible explanation for the sex differences in encoding in this study is the different role expectations for males and females. In our culture, females may have more practice in encoding positive than negative vocal intonations (and the reverse may hold for males) because of sex role expectations. In any event, it seems safe to conclude that males and females do not differ on some general ability to encode all levels of vocal intonation. Other factors must be taken into account (such as sex role factors) to predict sex differences in paralinguistic encoding.

Decoding does appear to be more directly related to a general sex difference between males and females. The present data suggest, however, that sex role may also serve to qualify predictions. In particular, there was a general tendency for females to be more accurate decoders than males for all levels of positive and negative vocal intonation. Although this difference attained statistical significance only for the extremely negative tone of voice, it confirms a general sex difference favoring female decoders observed in earlier research (Dimitrovsky, 1964; Dusenberry & Knower, 1939; Pfaff, 1953; Plazewski & Allen, Note 1). The present data are important for showing that a sex differential is particularly strong in decoding extremely negative tone of voice. On the basis of the present data, it appears that females are particularly more sensitive than males in interpreting extremely negative tones of voice, and this could be related to sex role differences. Perhaps due to sex role socialization, females are trained to be more sensitive to signs of disapproval than males in our culture.

The Social Skills Model for Paralinguistic Encoding

Encoders produced positive vocal intonations less accurately in the absence of auditory feedback than when auditory feedback was available (consistent with hypothesis 1). The opposite effect was found, however, for encoding negative vocal intonations. The social skills model is apparently correct for positive vocal intonations. When encoders could hear their own vocal inflections, they more accurately encoded positive vocal intonations than when they were unable to monitor their voices. Apparently auditory feedback enabled encoders to monitor vocal inflection

and conform to stereotypic ways of communicating positive vocal affect. Preventing auditory feedback disrupted this process, resulting in less accurate encoding of positive affect.

Similarly, the social skills predictions for hypothesis 2 were supported for the encoding of positive vocal affect, but not for negative affect. Particularly at the moderate level of friendly vocal intonation, absence of auditory feedback resulted in less accurate encoding of inconsistent paralanguage (the sentence with negative content) than consistent paralanguage (the sentence with positive content). Apparently, for positive intonations, inconsistent paralanguage is more difficult for encoders to produce than consistent paralanguage, and therefore more strongly inhibited when auditory feedback is prevented. Encoders must be able to hear their vocal inflections in order to produce accurate positive paralinguistic affect that conflicts with the literal content of the sentence encoded. Such self-monitoring is apparently less needed for tailoring consistent positive paralanguage to stereotypical conventions that ensure accurate encoding.

Why should hypotheses 1 and 2 hold for encoding positive affect but not negative affect? Two explanations suggest why positive vocal intonations more appropriately test the social skills model. First, prevention of auditory feedback may have caused encoders to speak louder, especially when producing negative tones of voice. Thus, encoding negative intonations, whether consistent or inconsistent with literal content, may have been easier when auditory feedback was absent. Second, in general the

positive levels of vocal intonation are probably more subtle inflections than negative tones of voice. Consequently, the social skills involved in producing different kinds of consistency and inconsistency should be most salient for the encoding of positive paralinguistic affect. Differential encoding of positive paralanguage as a function of auditory feedback conditions provides the best information about encoding processes with respect to such testing grounds.

Finally, the present data provide strong support for the social skills formulation of hypothesis 3. The accuracy of encoding positive inconsistency (positive vocal intonations encoded for messages with negative verbal content) decreased when auditory feedback was absent. However, the lack of feedback actually increased the accuracy of encoding negative inconsistency (negative vocal intonations encoded for positive content). As expected from the social skills approach, self-monitoring of vocal inflections is more central to encoding subtle and rarely practiced inconsistency (positive inconsistency) than it is to encoding paralanguage associated with negative inconsistency, which is more commonly used in everyday life.

Reference Notes

1. Plazewski, J. G., & Allen, V. L. The paralinguistic encoding capability of children (Working Paper No. 441). Madison, Wis.: Wisconsin Research and Development Center for Cognitive Learning, 1977.

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